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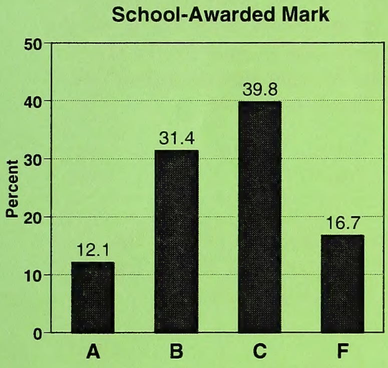
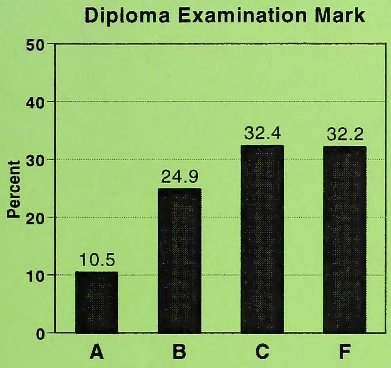
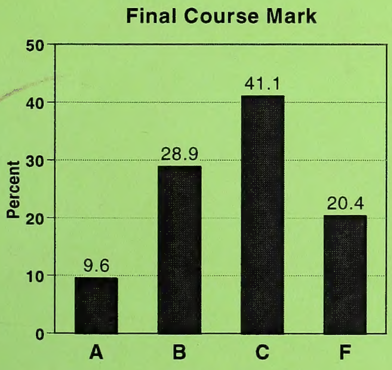
Mathematics 33

Diploma Examination Results
Examiners' Report for June 1999







The summary information in this report provides teachers, school administrators, and students with an overview of results from the June 1999 administration of the Mathematics 33 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that are provided electronically to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, June, and August results is made available annually.

Description of the Examination

The Mathematics 33 Diploma Examination consists of 37 multiple-choice questions worth 53%, 12 numerical-response questions worth 17%, and four written-response questions worth 30% of the total examination.

Achievement of Standards

The information reported is based on the final course marks achieved by 6 107 students in Alberta who wrote the June 1999 examination and received a school-awarded mark.

- 79.6% of the 6 107 students achieved the *acceptable standard* (a final course mark of 50% or higher).
- 9.6% of the 6 107 students achieved the *standard of excellence* (a final course mark of 80% or higher).

Overall, student achievement in Mathematics 33 was satisfactory. The percentage of students who achieved the *acceptable standard* (79.6%) was similar to the percentage for June 1998 (79.7%). Most students were successful when answering questions involving graphs and tables that represented various functions and relations, statistical concepts, and processes related to rational and radical expressions. Some students had difficulty with concepts related to finances and to trigonometric and quadratic functions.

Approximately 51.4% of the students who wrote the examination were female. Of these, about 81.5% achieved the *acceptable standard* for a final course mark, compared with 77.6% of the male students. Approximately 10.2% of the female students achieved the *standard of excellence* for a final course mark, compared with 8.9% of male students. The average diploma examination mark was 60.9% for female students and 59.0% for male students.

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Provincial Averages

- The average school-awarded mark was 61.8%.
- The average diploma examination mark was 57.4%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 60.0%.

Of the 6 107 students who wrote the June 1999 examination and received a school-awarded mark 457 had written at least one other Mathematics 33 Diploma Examination during the June 1998 to June 1999 period. This subpopulation (457) achieved an examination average of 51.3%, compared with 57.9% for the population (5 650) who first wrote the Mathematics 33 examination in June 1999. The group of students who rewrote increased their examination average score by 10.4%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It was designed so that students achieving the *acceptable standard* will obtain a mark of 50% or higher, and students achieving the *standard of excellence* will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score (out of 1) achieved by students who wrote the examination.

Course Units:

RF	Relations & Functions
Q	Quadratic Functions & Equations
PR	Powers & Radicals
RE	Polynomials & Rational Expressions
TR	Trigonometry
ST	Statistics
AML	Annuities, Mortgages, & Loans

Mathematical Understandings:

P	Procedure
C	Concept
PS	Problem-solving

Blueprint

Question	Key	Difficulty	RF	Q	PR	RE	TR	ST	AML	Math Und.
NR1	3.1	0.828						✓		P
MC1	D	0.725						✓		PS
MC2	C	0.637		✓						PS
MC3	B	0.634	✓							C
MC4	C	0.938	✓							C
MC5	B	0.833							✓	P
WR1	—	0.532					✓			P/C/PS
NR2	2341	0.698					✓			PS
MC6	D	0.344					✓			C
MC7	A	0.850		✓						P
MC8	B	0.703					✓			P
NR3	2.47	0.596				✓				P
MC9	C	0.483					✓			C
MC10	A	0.650	✓							C
MC11	D	0.299		✓						C
MC12	D	0.753		✓						C
MC13	A	0.557		✓						C
NR4	40.5	0.383		✓						P

Question	Key	Difficulty	RF	Q	PR	RE	TR	ST	AML	Math Und.
MC14	D	0.522		✓						C
MC15	C	0.624	✓							P
MC16	A	0.270	✓							P
MC17	D	0.747				✓				P
MC18	B	0.569				✓				P
MC19	C	0.539				✓				C
MC20	B	0.702			✓					P
NR5	230	0.492			✓					PS
MC21	C	0.647			✓					P
MC22	B	0.740			✓					P
WR2	—	0.416		✓	✓					P/C/PS
MC23	B	0.764					✓			P
NR6	1081	0.556							✓	P
MC24	C	0.392				✓				C
MC25	A	0.605							✓	PS
NR7	6488	0.297							✓	PS
MC26	D	0.605							✓	C
MC27	C	0.557	✓							C
NR8	118	0.447					✓			P
WR3	—	0.608	✓							P/C/PS
MC28	A	0.591			✓					C
MC29	A	0.475			✓					P
NR9	42.1	0.334					✓			PS
NR10	80	0.550						✓		PS
MC30	D	0.588						✓		C
MC31	C	0.686	✓							C
MC32	B	0.560	✓							C
MC33	A	0.705					✓			PS
MC34	B	0.637					✓			P
MC35	D	0.532				✓				C
NR11	22.6	0.686			✓					P
WR4	—	0.522						✓		P/C/PS
MC36	C	0.529						✓		PS
NR12	21	0.788	✓							P
MC37	A	0.474						✓		P

Subtest: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 29.1 out of 49
Multiple-choice: 22.5 out of 37
Numerical-response: 6.7 out of 12

Written response: 11.0 out of 21

Raw Score Average for Machine-Scored Questions by Mathematical Understandings*

- Procedural (P): 13.3 out of 21
- Conceptual (C): 10.2 out of 18
- Problem Solving (PS): 5.6 out of 10

Raw Score Averages for Machine-Scored Questions by Course Unit

RF	Relations & Functions	5.7	out of	9
Q	Quadratic Functions & Equations	5.1	out of	7
PR	Powers & Radicals	3.3	out of	7
RE	Polynomials & Rational Expressions	3.4	out of	6
TR	Trigonometry	5.1	out of	9
ST	Statistics	3.7	out of	6
AML	Annuities, Mortgages, & Loans	2.9	out of	5

* Refer to the 1999–2000 *Mathematics 33 Information Bulletin, Diploma Examinations Program* for an explanation of mathematical understandings.

Multiple-Choice and Numerical-Response Questions

Questions on the examination are organized into scenarios or practical situations that occur in real life. For the June 1999 Mathematics 33 Diploma Examination, personnel from Imperial Oil Resources Limited (Cold Lake), Canmore Nordic Centre, and Edmonton Space & Science Centre assisted teachers in the development of questions and scenarios. The multiple-choice, numerical-response, and written-response questions were integrated within each scenario of the examination, and, where appropriate, questions from the same unit of the course were organized together.

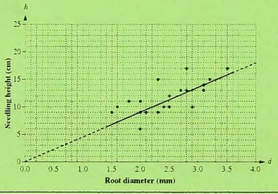
The following table gives results for six machine-scored questions selected from the examination and shows the percentage of students in four groups that answered each question correctly. The comments that follow the table relate to some of the understandings and skills that students may have used to answer these questions.

Percentage of Students Correctly Answering Selected Machine-Scored Questions

	Question Number					
Student Group	**MC 1**	**MC 6**	**MC 11**	**NR 4**	**MC 17**	**NR 10**
All Students	72.5	34.4	29.9	38.3	74.7	55.0
Students achieving the *standard of excellence* (80% or higher, or A) on the whole examination	87.9	52.8	58.7	68.4	96.6	88.3
Students achieving the *acceptable standard* but not the *standard of excellence* on the whole examination	76.4	36.4	30.6	41.8	81.3	64.2
Students who have not achieved the *acceptable standard* (49% or less, or F) on the whole examination	60.7	24.9	19.1	22.4	55.6	27.9

Use the following information to answer the next question.

A pulp and paper company operates a tree nursery to provide seedlings for reforestation. To analyze the relationship between the height of tree seedlings and their root diameter, a biologist completed the scatter plot shown below. He included a line of best fit.



Use this additional information to answer the next question.

The biologist made the following inference based on the line of best fit: "As the root diameter increases, the seedling height _i_ at a rate of about _ii_ cm per 1.0 mm increase in root diameter."

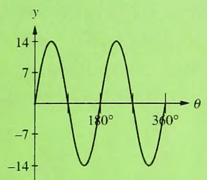
1. The row that completes the statement above is row

Row	*i*	*ii*
A.	decreases	5.5
B.	increases	5.5
C.	decreases	4.5
***D.**	increases	4.5

Multiple-choice question 1 required students to complete an inference indicating the direction of the correlation of a scatter plot and to use problem-solving skills to find the slope of the line of best fit. Both students who achieved the *acceptable standard* and those who achieved the *standard of excellence* responded well to this question. The most common incorrect alternative chosen was B, which indicates an incomplete understanding of the slope of line.

Use the following information to answer the next question.

A technologist at the plant monitors the voltage output pattern of a generator, as illustrated below.



6. An equation that could be used to produce the graph above is

A. $y = \sin 2\theta$
B. $y = \sin 14\theta$
C. $y = 14 \sin \theta$
***D.** $y = 14 \sin 2\theta$

Multiple-choice question 6 is classified as a trigonometry unit question. This question required students to determine the trigonometric function ($y = a \sin bx$) corresponding to the graph of a sine curve. By choosing alternatives C or D, most students (77.8%) indicated that they understand the relationship between the amplitude and parameter "a." However, less than half of these students were able to correctly connect the period of 180° to the correct "b" parameter, as was indicated by their choice of alternative D.

Use the following information to answer the next question.

To convert the quadratic function $y = -2x^2 + 4x + 13$ into the completed square form $y = a(x - h)^2 + k$, a student performed the following steps.

Step I $y = -2(x^2 - 2x) + 13$
Step II $y = -2(x^2 - 2x + 1) + 13 + 2$
Step III $y = -2(x^2 - 2x + 1) + 15$
Step IV $y = -2(x + 1)^2 + 15$

11. The student made an error in

A. step I
B. step II
C. step III
***D.** step IV

In **multiple-choice question 11**, students had to analyze the four steps required to "complete the square" of a quadratic function and to find the error. This question seemed difficult for students, even though the factoring error in step IV is fairly obvious. Alternative B was chosen by many students who may have thought there was an error in adding the value +2 outside of the brackets (perhaps thinking that it should be –2 because of the –2 multiplier in front of the bracket).

Numerical Response

4. The y-intercept of the graph of the function $y = 0.5(x - 9.0)^2$, to the nearest tenth, is ________.

(Record your answer in the numerical-response section on the answer sheet.)

Answer: 40.5

Numerical-response question 4 is another question in the Quadratic Functions and Equations unit. This question required students to find the y-intercept of a function. To solve this question, students could set x equal to zero, square –9, and multiply by 0.5. The two most common errors made by students were to either forget to multiply by 0.5 (giving them an answer of 81.0) or to misinterpret the x-coordinate of the vertex as the y-intercept (giving them an answer of 9.0).

17. The expression $\dfrac{x^2 + 5x}{4x^2 + 16x - 20}$, where $x \neq 1$ or -5, is equivalent to

A. $\dfrac{1}{16}$

B. $-\dfrac{2}{11}$

C. $\dfrac{x}{x - 4}$

***D.** $\dfrac{x}{4(x - 1)}$

Use the following information to answer the next question.

> Over a one-month period, management at the museum conducted a survey on a random sample of patrons. To the question, "Is the cost of admission reasonable?", 12 patrons said "**yes**." Using a 90% box plot, management determined that the 90% confidence interval was between 10% and 20%.

Numerical Response

10. The sample size of patrons surveyed was ________.

(Record your answer in the numerical-response section on the answer sheet.)

Answer: 80

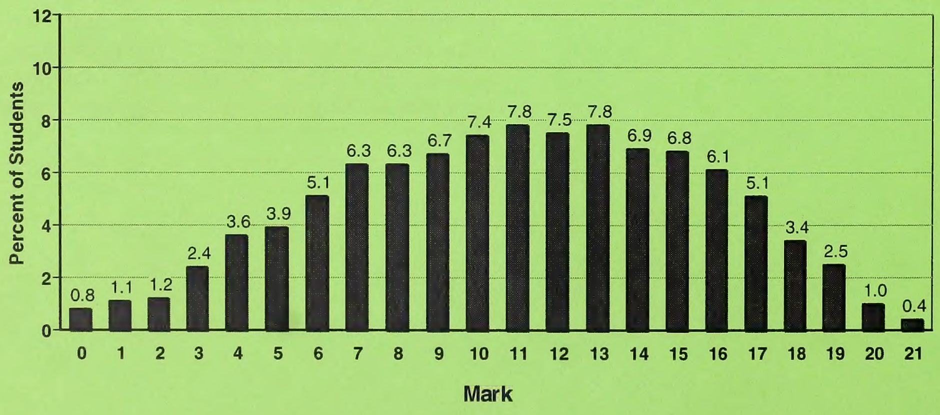
Multiple-choice question 17 is a routine question in the Polynomials and Rational Expressions unit. Most students successfully factored and simplified the rational expression. This question discriminated well between students achieving each standard. The most common incorrect alternative, C, was probably chosen by students who factored the denominator incorrectly.

For **numerical-response question 10**, students were required to use problem-solving skills related to the Statistics unit. Given the findings and predicted values of a particular survey, students were to use the 90% box plot charts in the data booklet to find the appropriate sample size. A large proportion of students realized that given 12 "yeses," a vertical line passed only though the 10% to 20% boxes in the size 80 chart.

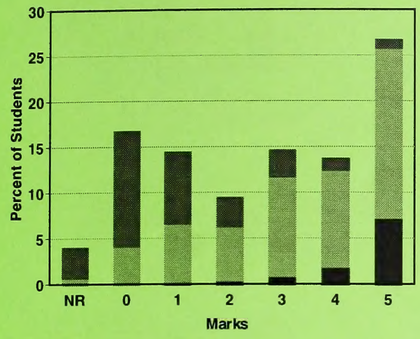
Written-Response Questions

The graph below shows the percentage of students achieving various marks on the written-response questions. The maximum mark obtainable was 21. Of the students who wrote the examination, 0.8% received no marks for the written-response questions, 55.3% received 11 marks or more (*acceptable standard*), and 12.4% received 17 marks or more (*standard of excellence*) out of 21.

Distribution of Marks for Written Response

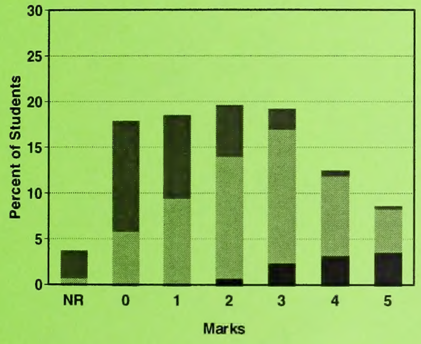


Distribution of Marks for Question 1



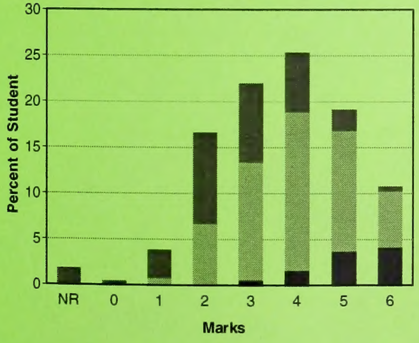
Question 1 required students to solve an applied trigonometry problem involving multiple triangles. The question was marked on a five-point holistic scale, and the average score was 2.66 (53.2%). Markers reported that student responses demonstrated strengths in referencing variables, using equal signs and mathematical syntax, and providing units in final answers. Most students were able to select an appropriate trigonometric law or ratio to solve for a missing side in either part b. or part c. and to find $\angle DBA$ to be 50°. Some weaknesses in student responses were also identified. A large proportion of students (20.8%) still do not get even one mark on this type of question. Some students did not indicate the measure of $\angle DBA$ on the diagram. Other errors included applying an incorrect trigonometric ratio to solve for x in part b., rounding errors, and using the "length" of the ramp instead of the "height" to explain compliance with the safety regulation in part c.

Distribution of Marks for Question 2



Question 2 required students to analyze and correct a simple radical equation set to equal a negative number, and then to solve and verify another radical equation whose solutions were roots of a quadratic equation. The question was marked on a five-point holistic scale, and the average score was 2.08 (41.6%). In part b., markers indicated that the majority of students successfully collected like terms to set the quadratic equation equal to zero. They were then able to solve the quadratic equation by either factoring or substituting values into the quadratic formula. Weaknesses in student responses were evident in the conceptual and communication errors made. In part a., some students used incorrect terminology or poor logic to explain why the radical equation could not have real roots. For example, students often confused "squaring" with "square root." In part b., a number of responses demonstrated a lack of clear understanding of verification. Many students verified only the value of $x = 7$, saw verification as their statement of the solution by solving for x in the right side of the equation, or "squared" both sides while verifying.

Distribution of Marks for Question 3



▨ Below Standard on the Examination

▨ Acceptable but not Standard of Excellence on the Examination

■ Standard of Excellence on the Examination

Question 3 required students to interpret two graphs and to draw the sketch of another graph related to the temperature fluctuation of dinosaurs over a 24-hour period on land and in water. The question was marked on a six-point scale. One point was available for the answer to part a., and five points were available for the answer to parts b., c., and d. The average score on this question was 3.65 (60.8%). Teachers marking the question noticed that there were very few "no responses" (1.8%) and that most students attempted all parts of the question. Students were successful in finding the difference in temperature in part a. and in sketching a reasonable graph in part d. Students also provided reasonable and often insightful explanations for the changes in temperature for both dinosaurs in part c. However, weaknesses in student responses were also evident, especially in part b. Some students used inequality signs incorrectly, presented

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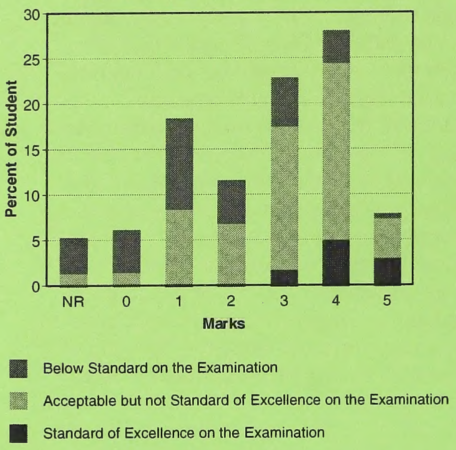
Distribution of Marks for Question 4



incorrect functional notation, or misrepresented the range (i.e., they stated a statistical range value by subtracting the maximum and minimum values). Other students forgot to mention maximum/minimum values in part b. and specific numerical evidence from graphs in their explanations in part c.

Question 4 required students to complete and write 90% confidence interval statements for survey results from two different sample sizes and to explain why the confidence intervals differed. The question was marked on a five-point holistic scale, and the average score was 2.61 (52.2%). Most students attempted all parts of the question and were quite successful in completing and writing confidence intervals in part a. and in understanding that a larger sample would be able to provide a more accurate prediction of the population in part b. Markers were concerned about the larger percentage of "no responses" (5.3%) and "zeros" (6.1%) for this question. Weaknesses in student responses were evident in that students did not understand the relationship between sample size and confidence interval. Some students also misread the confidence interval from their data charts by reading horizontally instead of vertically or by not including edges of boxes when reading vertically.

Overall, markers reported that all students were given a fair opportunity to be successful on the written-response questions. Many students would have enhanced their grades on these questions by reading all instructions carefully, paying attention to detail, and communicating answers with evidence and support.

Markers also felt that all questions on the examination were fair and set an appropriate standard for Mathematics 33 students.

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